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ABSTRACT

A study was conducted to investigate the facilitation of learning word pairs (paired associate learning) using connected text rather than the unrelated, simple sentences of previous research. Each of 64 fifth graders, classified as either a high or a low reading achiever, was assigned to one of four presentation conditions: (1) hear sentences/read sentences with instructions to learn about the story, (2) hear sentences/read sentences with instructions to learn pairs of underlined words, (3) hear sentences/read word pairs with instructions to learn about the pairs, and (4) hear pairs/read pairs with instructions to learn about the pairs. In all conditions except the fourth, elaboration (the addition of auxiliary description to aid in learning) was demonstrated to students. Analysis of the results indicated that, for the high reading achievers, learning was facilitated most by condition three (hear sentences/read word pairs), while the low achievers performed best under conditions two (hear sentences/read sentences) and three (hear sentences/read word pairs). The results demonstrate the importance of achievement level to paired associate learning and suggest the application of elaboration research findings to school learning. (GW)

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Technical Report No. 180

ELABORATION AND READING ACHIEVEMENT AS FACTORS IN CHILDREN'S LEARNING OF TEXT MATERIALS

Report from the Project on Variables and Processes in Cognitive Learning

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STATEMENT OF FOCUS

The Wisconsin Research and Development Center for Cognitive Learning focuses on contributing to a better understanding of cognitive learning by children and youth and to the improvement of related educational practices. The strategy for research and development is comprehensive. It includes basic research to generate new knowledge about the conditions and processes of learning and about the processes of instruction, and the subsequent development of research-based instructional materials, many of which are designed for use by teachers and others for use by students. These materials are tested and refined in school settings. Throughout these operations behavioral scientists, curriculum experts, academic scholars, and school people interact, insuring that the results of Center activities are based soundly on knowledge of subject matter and cognitive learning and that they are applied to the improvement of educational practice.

This Technical Report is from the Project on Variables and Processes in Cognitive Learning in Program 1, Conditions and Processes of Learning. General objectives of the Program are to generate knowledge and develop general taxonomies, models, or theories of cognitive learning, and to utilize the knowledge in the development of curriculum materials and procedures. Contributing to these Program objectives, this project has these objectives: to ascertain the important variables in cognitive learning and to apply relevant knowledge to the development of instructional materials and to the programming of instruction for individual students; to clarify the basic processes and abilities involved in concept learning; and to develop a system of individually guided motivation for use in the elementary school.

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ABSTRACT

The purpose of this experiment was to investigate sentence facilitation of paired associate learning using connected text rather than the unrelated, simple sentences of previous research. Each of sixty-four fifth graders, classified as either a High or Low reading achiever, was assigned to one of four presentation conditions: hear sentences/read sentences with instructions to learn about the story, hear sentences/read sentences with instructions to learn the pairs of underlined words, hear sentences/read pairs, and hear pairs/read pairs. This study replicated other recent experiments which have failed to find sentential facilitation of PA learning when the sentences are both heard and read. For the High readers, learning was facilitated when the sentences were heard but only the pairs were read, while the Low readers performed better when both elaboration and instructions to learn the pairs were given than in the conditions where either elaboration or instructions was missing. The results of this study demonstrated the importance of achievement level to PA learning and suggested the application of elaboration research findings to school learning.

INTRODUCTION

Intuitively, spurring a flagging memory by increasing the amount of material to be learned may not appear to be the best way of doing things. Yet, there are few of us who, as eight-year-olds, did not smooth the way to learning by the use of such aids as the sentence, "A rat in Tom's house may eat Tom's ice cream," to remember such stubborn facts as the spelling of "arithmetic". Similarly, there is a variety of sentences which may be used to remember the order of the planets from the Sun, and medical students employ a similar device to remember the seven cranial nerves.

This traditional device of adding auxiliary description to aid in learning has been brought into the laboratory under the title "elaboration" (Rohwer, 1967) and studied as a facilitator of paired associate (PA) learning. One line of research has compared the facilitative effects of various kinds of connectives as mediators for word pairs. Rohwer (1966), for example, used groups which read PAs embedded in conjunctive phrases, prepositional phrases, and sentences. Compared to a traditional PA control group, the groups which were given verbs (in a sentence) or prepositions (in a phrase) as mediators learned better, while the group which read conjunctions showed no difference from the controls.

In another study using similar materials, Rohwer, Shuell, and Levin (1967) investigated the hypothesis that the facilitative effect of sentences and the lack of an effect with conjunctions might be due

to greater availability of the sentences at the time of recall. To test this hypothesis, they presented the entire context, either sentence or conjunctive phrase, as the stimulus during the test trials for two groups of subjects. Despite the equal availability of the verbs and conjunctions, the conjunctions did not facilitate learning as the sentences did. In fact, the facilitative effect was descriptively greater for sentences in the context-as-stimulus condition than in the condition where only the first word of the pair served as stimulus.

Facilitation of learning has also been found when pairs of pictures to be associated are mediated by an orally presented sentence (Davidson and Dollinger, 1969; Rohwer, Lynch, Levin, and Suzuki, 1968). Thus, given a picture of a ball beside a rabbit, children who hear a sentence such as, "The BALL bounces to the RABBIT", learn better that the two pictures go together than children who do not hear the sentence.

Thus, with the use of elaboration as a facilitator of children's PA learning fairly well extablished, it was surprising when four recent studies failed to find an effect of sentence mediation (Davidson, Schwenn, and Adams, 1970; Levin, 1970; Levin and Horvitz, in press; Yuille and Pritchard, 1969). These four studies, although investigating different aspects of elaboration, e.g. noun concreteness (Yuille and Pritchard, 1969) or nature of the stimulus (Levin, 1970), used paradigms which were similar in at least one respect: the sentences which failed to facilitate were read aloud to the subject as he read silently.

Davidson et al. (1970) proposed that simultaneous oral and visual presentation had tended to inhibit the sentence groups in their study

by providing a great many extraneous visual cues. As support for this hypothesis, they cited the high proportion of intralist intrusions--adjectives and verbs from the sentences--in the errors made by the sentence groups. The implication of this explanation would seem to be that the children had learned the mnemonic, the auxiliary material, but in doing so had interfered with the learning of the embedded "fact" or paired associate.

In order to test whether the simultaneous oral-visual presentation of sentences was indeed the major factor in eliminating the previously reliable effect of elaboration, Levin, Horvitz, and Kaplan (in press) reported two experiments investigating the problem. In the first experiment fifth graders were assigned to one of four groups: those who heard and read complete sentences containing an embedded pair of nouns to be associated, those who heard the sentences but read only the pairs of words, and two similar groups who heard, or heard and read, a conjunctive phrase in place of the sentence. As predicted, the oral-visual presentation of the sentences failed to facilitate learning compared to the control group which read and heard a conjunctive phrase containing the pairs, while the condition in which the sentences were presented orally in the company of visual pairs was facilitative relative to the corresponding conjunction group.

In the second experiment the authors employed a mixed list design with another group of fifth graders. That is, each subject was given a list which contained an equal number of items from each of the four conditions in Experiment I. When the subjects' relative performance

on each type of item were compared, the results were similar to those of the first experiment. Again, the oral-visual method of presenting sentences did not facilitate while the oral sentence-printed pair method was facilitative.

Unfortunately, there were too few overt errors in the Levin et al. (in press) study to substantiate the notion of Davidson et al. (1970) about intralist intrusions. However, Levin and his colleagues offered another hypothesis to explain the facilitation of their hear sentences/read pairs condition and the lack of this effect for the hear sentences/read sentences condition. They suggested that the children who only heard the sentences and did not read them were induced to process some of the mediation for themselves (in order to derive meaning from it), thus entering more actively into the learning process than those children who were given the full elaboration.

This suggestion is an appealing one since Bobrow and Bower's (1969) work with college students has indicated that sentences generated by the subject are generally more effective mediators than those provided by the experimenter. It also makes good intuitive sense that manipulating the material to be learned, in a manner of the learner's choice, ought to be more effective than simple intake. Teachers have used this idea in assigning students to make up sentences with new vocabulary words, performing skits from stories, and so on.

However, while the generative hypothesis explains the facilitative effect of hearing the sentence and reading only the pairs, the hypothesis does not accurately explain the lack of facilitation for hearing and

reading sentences. One possible alternative is that the former condition is facilitative because of the active participation by the learner suggested by Levin et al. (in press) and at the same time the latter condition is inhibiting because of extraneous visual cues as suggested by Davidson et al. (1970).

To visualize how these separate effects might work, a value representing the basic effect of sentence facilitation in learning of paired associates might be imagined. Suppose the learning of a straight PA list were x, where x equalled a number of correct responses. Learning the pairs within a sentence might be $x + y$, with y equal to some number of additional correct responses attributable to the mediation of the sentence. When the sentence is both heard and read, the value is reduced by some number of responses, z, yielding $x + y - z$. The quantity z is composed of two quantities: a, distraction from extraneous visual cues, and b, lack of opportunity to participate actively in the learning process. Factors a and b may both contribute to z in some ratio as yet undemonstrated; or, if one hypothesis is true and the other false, a or b may equal zero.

Another explanation for the difference in facilitation when pairs or sentences are read may lie in the large difference in speed between oral and silent reading. An adult reading sentences aloud generally will not produce them as quickly as they can be absorbed silently by a child who is a good reader. The alternatives for the child who is reading silently are to try to slow his reading speed so that the same word is taken in from both modes of stimulation, to ignore either the

visual or oral mode, to try to learn from the two modes separately, or to give up. An equivalent for this situation in the adult world is reading the instructions for a group test while the test administrator reads them aloud. This situation is unpleasant, whether boring or irritating.

The reading speed hypothesis is consistent with the findings of both the Davidson et al. (1970) and Levin et al. (in press) studies. The intrusions from the sentences which formed a large portion of errors in the former study could have come as easily from the orally presented sentence as the visually presented sentence. For example, a child finding himself confused by the difference in intake speed between the oral and visual modes might elect to attend only to the oral mode since the oral mode is apparently preferred (e.g. Senf, 1969). In doing so, he cannot attend as closely to the pairs which he is supposed to learn because the pairs are defined from the rest of the sentence by underlining and/or capital letters, cues which are of course not available in the oral modality. When the test trial comes, he may recognize the stimulus word but be unable to remember which word of the words he heard was the proper response word of the embedded pair. Facilitation when the sentences were heard and the pairs read in the latter study might have occurred because reading only two words was less disturbing in terms of speed difference than reading a whole sentence.

Objectives of the Present Study. Although the present study was

conceived as a partial replication of the Levin, Horvitz, and Kaplan (in press) study, the theoretical aspects of elaboration were not the center of investigation. It was felt, rather, that the theoretical implications of elaboration research would become even more important if they could be demonstrated as relevant to school learning. Hence, this study became an attempt to apply previous laboratory results to a continuous text presented in ways resembling possible teaching methods and also to take into account some factors, such as achievement level, with which teachers must deal. The finding that sentence mediation was not facilitative with a bimodal presentation of the sentences was seen as important since some of the experimental conditions in the Levin et al. study seemed to parallel some methods which might be used in the school.

For example, the group which heard and read the sentences resembles the class where one child reads aloud while others follow along reading silently. In this study, there were two groups of this type: the Emphasis group, which because of instructions to learn the embedded pairs was identical to the Levin et al. group, and the Paragraph group, which was instructed to learn about the story and thus might have resembled a school assignment. The Pairs group in the present study also duplicated a condition in the Levin et al. study, where the subjects heard the sentence and read only the pairs. One of the control groups in the Levin et al. study read and heard the paired associates in a conjunctive phrase whereas the Control group in the present study read

and heard only the pairs. While these two groups are not identical, they may be considered fairly equivalent since, as previously discussed, the use of conjunctive phrases seems to have no effect on the learning of noun-noun associates (Rohwer, 1966; Rohwer, Shuell, and Levin, 1967). The Levin et al. group which heard conjunctive phrases and read the pairs alone is not represented in the present study.

The parallel between laboratory and classroom exemplified by experimental conditions in the Levin, Horvitz, and Kaplan (in press) study and teaching methods also extends to elaborated material. School textbook material resembles the elaborated material used in PA learning experiments in several ways: it contains more information than the child will be called on to produce; important words or ideas are often printed in different type so that they stand out; and the description in the paragraphs is intended to clarify, give meaning to, or make interesting (i.e., elaborate) these important words or ideas. There are also some important differences between experimental and school materials, however. The sentences used in elaboration research typically are short, all of equal length, unrelated to each other, and of the same grammatical structure.

In preparing the materials for this study, some desirable characteristics of experimental and classroom materials were included. Thus, the basic learning task was a paired-associate test which had the advantage of dealing with a single correct response, but the stimulus words were presented in question form with the response word being a factual answer. The sentences used were presented one

at a time and each contained a PA "fact" to be learned, in traditional laboratory style, but unlike the usual experimental material, the sentences used in this study varied in length and grammatical structure, were complex or compound, and related to each other as a continuing text. It was felt that if this preliminary study which used fairly rigorous methods of measurement and control yielded promising results, an experiment approaching the classroom even closer, perhaps using actual textbooks, might follow.

Learning of Ideas. Using connected discourse suggested the addition of a test measuring the learning of general information from the passage and the transfer of this information to a different situation. It is important that with the improvement of fact learning there is no loss in the learning of ideas or concepts. (This paper will follow the common usage of the term "concept", referring to an idea and transfer of the idea, rather than the narrower technical definition used by such authors as Bourne and Gagne.)

However, the hear sentence/read pair method of presentation in this study appeared to be a method which, by directing attention to only two words of the sentence, might discourage attention to the global meaning of the text. That is, even if the child used the meaning of the individual sentences to associate the noun pairs contained in the sentences, he might not attend to the relationship of the sentences to each other in forming a unified text. Instructions to learn that the two underlined words go together might also dis-

tract the learner from attending to the sentences as parts of a connected story. In a related study, Bobrow and Bower (1969) found that college students who performed a task involving comprehension of sentences remembered the sentences better than those subjects who performed tasks involving attention to visual or phonetic aspects of the sentences.

That concentration on visual aspects of a sentence might be separate from attention to the meaning of the sentence was suggested also by Begg and Paivio (1969), who found that college students could find changes in wording more easily for abstract sentences but changes in meaning more easily for concrete sentences. Although these results do not lead to any clear prediction for learning of meaning in the present study, they do suggest that learning of ideas is affected by conditions of the sentences containing the ideas and that attention to physical attributes of the sentence might also be a factor. It was expected that the relative performance of the two groups which read and heard sentences might relate to this question since the Paragraph group was told to learn about the story, or concentrate on meaning, while the Emphasis group was told to learn the pairs of words, or concentrate on a non-meaningful aspect of the sentences.

Achievement Level. Since reading ability is an important factor in text and PA learning (e.g. Stevenson, Hale, Klein, and Miller, 1968; Lambert, 1970), the children for this study were divided into High and Low Achievers. It was felt that a method which facilitated learning

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for poor readers might have little effect for good readers. By fifth grade, many of the brighter children can generate their own strategies of learning (confirmed by interviews with numerous fifth graders who had performed very well on an unelaborated PA task). These children might prefer to use their own strategies independently of the strategies suggested by the presentation method.

Hypotheses. In summary, the purpose of the present study was to extend the findings of Levin, Horvitz, and Kaplan (in press) to a situation resembling school learning. The effects of four methods of oral-visual presentation were compared for both concept and PA learning and between achievement levels. The four methods were (1) hear sentences/read sentences (Paragraph), (2) hear sentences/read sentences with instructions to learn the underlined words (Emphasis), (3) hear sentences/read pairs (Pairs), and (4) hear pairs/read pairs (Control).

For both the PA and concept tasks, the High Achievers were expected to perform better than the Low Achievers. Within each achievement level the Pairs group was expected to perform much better on the PA task than the Control group. On the basis of the Levin et al. (in press) results it was expected that the Paragraph and Emphasis groups would perform only slightly better than the Control group. It was also recognized that High Achievers, because of their greater likelihood of using self-generated strategies, might show smaller differences among groups.

For the concept task, all three experimental groups in both achievement levels were predicted to perform better than the Controls, who had no exposure to the text. In fact, the Controls were given the test in order to check its validity and to control for contaminating factors such as subject information leak and imagery cues provided by the paired associates.

Because the Paragraph group was instructed to attend to the meaning of the text, it was expected that children in this condition might perform better than subjects in the other three conditions on the concept task. It was felt that performance on the concept task was difficult to predict, however, since the research evidence cited (Begg and Paivio, 1969; Bobrow and Bower, 1969) was obtained with college students and in the case of one study (Begg and Paivio), seemed to suggest that the relationship of meaningful learning and type of sentence was a complicated one. As with the PA task, it was recognized that the High Achievers might perform similarly under all three text conditions.

METHOD

Subjects. The Ss, 64 fifth graders from a schōol in a semi-rural area of the Midwest, were divided into two groups, High Achievers and Low Achievers, on the basis of Stanford Achievement Test reading scores (these scores were not available for four children at each level who were designated as high or low readers by their teachers). Because of the practical constraints of selecting equal numbers of Ss from four classrooms, the lowest reader in the High Achievement level had a standardized score one month lower than the two highest Low Achiever subjects. Means and standard deviations for reading achievement scores by condition are listed in Table 1. Analysis of variance revealed a significant difference between Achievement levels but no differences between groups. The teachers were asked to exclude from their class list any child with a known organic reading dysfunction. The 32 children at each reading level were randomly assigned to one of the four conditions.

Design and Materials. The design was a two by four randomized block with eight Ss per cell, as illustrated in Table 2. The four treatments were nested in the two achievement levels. The nested design was used so that differences in relative performance within each achievement level could be measured. It was considered possible that high and low readers might react differently to the method of presentation, with each group being facilitated by a different method. The nested design allowed for comparisons within reading levels to detect differences of this type. Printed text and pairs were presented on 5 x 8 inch index cards with one sentence or pair to a card. The cards were

Table 1

Mean Achievement Scores by Experimental Condition

High Achievement	Paragraph	Emphasis	Pairs	Control	Achievement
Mean	5.51	5.89	6.28	5.98	5.88
SD	.58	1.38	.96	.93	.97
Low Achievement					
Mean	3.72	4.08	3.80	4.00	3.90
SD	.53	.35	.32	.49	.43

Table 2

Experimental Groups

Achievement Level	Paragraph	Emphasis	Pairs	Control
High	Read text, listen to text; no instructions to learn pairs.	Read text, listen to text; instructed to learn that pairs go together.	Read pairs, listen to text; instructed to learn that pairs go together.	Read pairs, listen to pairs; instructed to learn that pairs go together.
Low	Same	Same	Same	Same

bound in a looseleaf note book so that they could be presented easily by the E. The aural material was presented on a tape recorder. PA test items were presented in the same fashion.

The text consisted of twelve sentences about an imaginary island written in a style resembling social studies textbooks (see Appendix A). Pilot data indicated that fifth graders found this passage fairly interesting and of low to moderate difficulty compared with their regular texts (see Appendix B). The two words in each sentence which were the paired associates were underlined for the two groups which read text (Paragraph and Emphasis). The pairs were capitalized but not underlined when read by the Pairs and Control groups.

Procedure. Subjects were run individually with the order randomized within groups of eight so that each group contained all eight possible combinations of treatment and achievement level. Instructions for the groups were as follows:

Paragraph. I'd like you to read a story about a place called Malahiki. While you are reading, you'll be hearing the same thing on the tape recorder. Try to learn as much as you can about the story because I'd like you to answer some questions about it after you finish. Here's an example. (Show card) If you read and heard the sentence, "The teacher helped the student," and later on I asked you, "Who did the teacher help?" what would you answer? Right, the student. Any questions? All right, let's begin.

Emphasis. I'd like you to read a story about a place called Malahiki. While you are reading, you'll be hearing the same thing on the tape recorder. You'll notice that in each sentence there are two words underlined. Try to remember that the two words in each sentence go together, because I'd like you to answer some questions about them after you finish. If you pay close attention to the story while you're reading and listening, it will help you learn the pairs of words that go together. Here's an example. (Show card) Suppose you heard and read the sentence, "The teacher helped the student," and later on I asked you, "Who did the teacher help?" You would think back to the word that went with teacher in the sentence and tell me...Right, the student. Any questions? All right, let's begin.

Pairs. I'd like you to read some pairs of words from a story about a place called Malahiki. While you are reading them, you'll be hearing the story on the tape recorder. You'll notice that each pair of words comes from a sentence in the story. Try to remember that the two words go together, because I'd like you to answer some questions about them after you finish. If you pay close attention to the story while you're listening to it and reading the pairs, it will help you learn the pairs of words that go together. Here's an example. (Show card) Suppose you read this pair of words, "teacher" and "student", and heard "The teacher helped the student" on the tape recorder, and later on I asked you, "Who did the teacher help?" You would think back to the word that went with teacher in the sentence and tell me...Right, the student. Any questions? All right, let's begin.

Control. I'd like you to read some pairs of words. While you are reading them, you'll be hearing them on the tape recorder. Try to learn which two words go together because I'd like you to answer some questions about them after you finish. Here's an example. (Show card) Suppose you read and heard the pair of words, "teacher" and "student", and later on I asked you, "What word went with teacher?" You would think back to the pair you learned and tell me...Right, student. Any questions? All right, let's begin.

The S was given another example so that it was clear he understood the instructions. No S had to be dropped from the study. The E then presented the cards and oral material. Both sentences and pairs were presented for ten seconds, the turning of cards being paced by a signal on the tape. The pairs were read aloud at the third and seventh seconds.

After reading and listening to the materials, S was reminded of the instructions for the PA task during a fifteen-second rest interval. All Ss were told to answer the question with the single best word. A list of the questions following the pairs' appearance in the text is given in Appendix C. In the actual tests the questions were in a random order different from that of the study trial.

A concept task (see Appendix D) was given to the three elaboration groups following another rest interval for instructions. The time for

this interval varied somewhat with the time necessary to assure that the S understood the instructions. The test consisted of twelve areas in which life on Malahiki might be different from life in Wisconsin. The Ss were told to give an example of such a difference for each area listed. Questions were read by the E.

In order to gain a rough idea of the effect of previous knowledge on responses to the concept task, the Control group was asked to perform the same task with the question re-worded to apply to life on an island in the South Pacific.

RESULTS

All hypotheses were tested with $\alpha = .05$. Comparisons between groups were nested within achievement level for reasons explained previously.

PA Task. Mean scores on the PA task are presented in Table 3. (Highest possible score is 12.) From the means for the two achievement levels it can be seen that the High Achievers performed better, as predicted, than the Low Achievers. An analysis of variance showed this difference to be significant ($F = 14.16$) as indicated in Table 4.

For the High Achievement level the Pairs group scored highest, as predicted, followed by the Controls and then the Emphasis and Paragraph groups which differed only by .4 of an item. Since the effect of treatments in High Achievement was significant ($F = 7.51$), pairwise comparisons following Scheffé's procedure were made showing that the difference between the Pairs and Control groups was not significant, nor did the Controls differ from the Emphasis and Paragraph groups. However, the Pairs group's performance was significantly better than both the Emphasis and Paragraph groups, whose performance did not differ significantly from each other. These comparisons are illustrated in Table 5.

The Low Achievement level shows a different pattern of scores. The Paragraph and Control groups are nearly equal, and the Emphasis and Pairs groups scored identically. A significant effect of treatment in Low Achievement was found, but there were no significant pairwise differences following Scheffé's procedure as shown in Table 5. It appeared that the Low Achievers divided on the basis of highly structured versus

Table 3

PA Task Results

	Paragraph	Emphasis	Pairs	Control	Achievement
High	4.25	4.62	9.25	6.50	6.16
Low	2.75	5.25	5.25	2.50	3.84
Treatment	3.50	4.94	7.25	4.50	

Table 4

Analysis of Variance for PA Task

Source	df	SS	MS	F
Achievement	1	78.76	78.76	14.16*
Treatment in Achievement	6	180.71		
Treatment in High	3	125.34	41.78	7.51*
Treatment in Low	3	55.37	18.46	3.32*
Error	56	311.37	5.56	

*$F_{1,56}(.95) = 4.01$, $F_{3,56}(.95) = 2.77$

Table 5

Post Hoc Comparisons for PA Task

For High Achievement:

Pairs	Control	Emphasis	Paragraph
9.25	6.50	4.62	4.25

Critical Difference (Scheffé): 3.40

For Low Achievement:

Pairs	Emphasis	Paragraph	Control
5.25	5.25	2.75	2.50

Critical Difference (Scheffé): 3.40
Complex: $\hat{\Psi}$ = 2.625 * (Pairs + Emphasis are significantly different from Paragraph + Control)
Critical Difference (Scheffé) = 2.40

less structured learning. They performed better in the Emphasis and Pairs conditions where both elaboration and instructions on how to learn were provided, than on the Paragraph and Control conditions where either the instructions were not explicit or the elaboration was lacking. A complex comparison using Scheffe's procedure to test this observation revealed that the Emphasis and Pairs groups combined performed significantly better than the Paragraph and Control groups combined.

The difference between High and Low Achievers within each condition showed a mean difference of four items for the Pairs and Control groups. For the Paragraph group, however, the difference was one and a half items, and for the Emphasis group there was about a two-thirds item difference in favor of the Low Achievers. These differences are more clearly illustrated in Figure 1.

Comparison with the Levin et al. Study. For comparison with the Levin et al. results, the data from the present experiment were reanalyzed using a one-way analysis of variance with the achievement levels collapsed (Table 6). As would be expected from the means by condition in Table 3, there was a significant effect of treatment ($F = 5.37$). The Pairs group exceeded the Emphasis, Control, and Paragraph groups in that order. However, pairwise comparisons following Tukey's procedure showed that the Pairs group differed significantly only from the Control and Paragraph groups, which did not differ from the Emphasis group. These comparisons are summarized in Table 7.

Concept Task. Responses on the concept test were highly influenced by previous knowledge. One of the classes involved had just com-

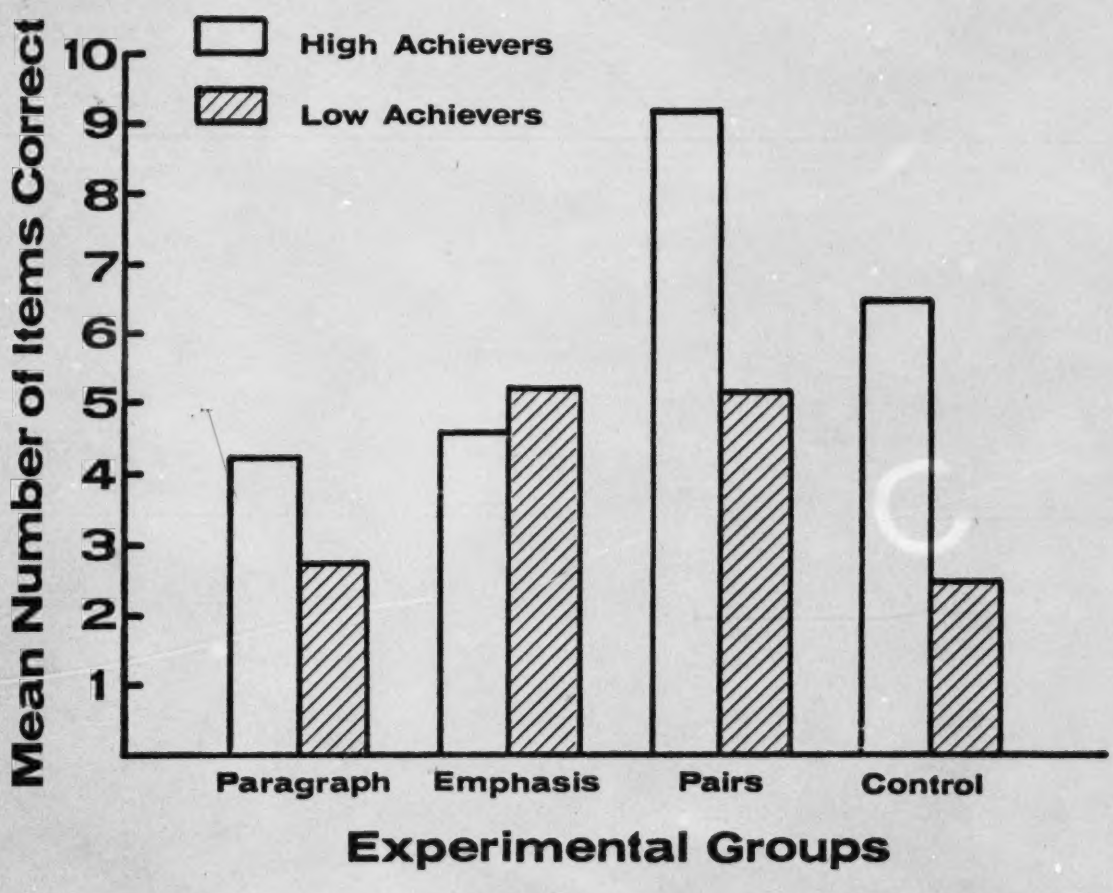

Figure 1

Results of PA Task by Experimental Condition

Table 6

One-way ANOVA for PA Task

Source	df	SS	MS	F
Treatment	3	120.91	40.30	5.37 *
Error	60	449.93	7.50	

* $F_{3,60(.95)} = 2.76$

Table 7

Pairwise Comparisons for One-way Analysis

Pairs	Emphasis	Control	Paragraph
7.25	4.94	4.50	3.50

Critical Difference (Tukey) = 2.56

Table 8

Results of Concept Task

	Paragraph	Emphasis	Pairs	Control	Achievement
High	6.88	7.38	9.00	5.38	7.16
Low	6.25	6.12	4.75	4.88	5.50
Treatment	6.56	6.75	6.87	5.13	

Table 9

Analysis of Variance for Concept Task

Source	df	SS	MS	F
Achievement	1	43.89	43.89	5.80*
Treatment in Achievement	6	68.84		
Treatment in High	3	53.59	17.86	2.36
Treatment in Low	3	15.24	5.08	< 1
Error	56	421.38	7.56	

*$F_{1,56(.95)} = 2.76$

pleted a unit on Hawaii; another class was preparing to start a similar unit. Other children reported watching a television program based on Hawaii. To compensate somewhat, responses were scored as follows: 0--an omission or incorrect response; 1--a correct response which could refer to any South Pacific island; 2--a correct response referring directly to the text. Because of this scoring system, four items which were too broad to have a possible two-point response were dropped from the analysis.

Results for the concept task are shown in Table 8. As predicted, the High Achievers scored higher than the Low Achievers. This difference was significant ($F = 5.80$) as shown in Table 9.

However, the only essential difference between the high and low readers on the concept task was found for the Pairs groups. The High Achievers in the Pairs condition scored highest of the four groups, while the Low Achievers scored lowest in this condition. This difference in relative performance resulted in a large difference (four items) between the High Achievers and Low Achievers in the Pairs condition, resembling their performance on the PA task.

There were no significant effects of treatment within achievement level. For both levels the Emphasis and Paragraph groups scored about the same and there was also little difference between achievement levels for these two groups. The two Control groups also performed about the same and for both levels did slightly poorer than the Emphasis and Paragraph groups.

DISCUSSION

PA Learning. As a paired-associate learning experiment, this study is in agreement with other PA results (e.g. Lambert, 1970) which have suggested the importance of reading ability in considering the effects of elaboration. The High and Low Achievers in this study appeared quite different from each other in their performance profiles across the conditions.

For the High Achievers, the nearly equal performance of the two sentence groups (Paragraph and Emphasis) indicated that instructions to attend to the underlined words made no difference for the good readers, suggesting that these children attend to important cues spontaneously. In contrast to the High Achievers, the Low Achievers were apparently helped by specific instructions on how to learn since the Emphasis group performed slightly better than the Paragraph group, in fact doing as well as the High Emphasis group. The comparison showing that the Emphasis and Pairs groups combined learned better than the Paragraph and Control groups combined suggests that the Low Achievement children needed a highly structured task as well as supplied elaboration in order to learn well. The Paragraph method lacked the specific instructions of the Emphasis and Pairs conditions, while the Control group was not given any elaboration.

The effect of the instructions for the Low Achievers and not the High Achievers is interesting. Levin (1970) found that his subjects performed no better with knowledge about the nature of the stimulus than subjects with more general instructions. However, he did not divide the chil-

dren by achievement level. It may be that poorer readers would have profited from instructions in the Levin experiment, also.

In order to demonstrate further the importance of achievement to verbal learning, a comparison of the present study to the Levin, Horvitz, and Kaplan (in press) experiments may be useful. The Emphasis and Pairs groups in the present study were identical to the complete context group and the hear context/read pairs group, respectively, in the Levin et al. experiments. Both studies found facilitation of learning when the sentences were heard but not read, but in the present study this effect was found only for the High Achievers. The Low Achievers scored identically in these two conditions.

Looking at the pairwise comparisons following the one way analysis of variance for the data in this study (Table 6), it is apparent that the large difference between the two groups for the High Achievers was nearly enough to reach a significant difference for the two achievement levels combined. The implication is that the lack of facilitation which was found for simultaneous oral/visual presentation of elaborative sentences may be a function of the performance of only the better readers.

Further theoretical implications from this study are not forthcoming, nor was the purpose to test any hypotheses regarding the reasons for sentential facilitation of PA learning at some times and not others. However, since the design of this experiment has increased the theoretical confusion by including achievement as a factor, a brief discussion of the present results in terms of the inhibition, participation, and reading speed hypotheses seems in order.

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The striking superiority of the High Achievement Pairs group to the two sentence groups, and also the surprisingly high scores of the Controls, may be plausibly explained by each of the three hypotheses. The two sentence groups might have been inhibited by extraneous visual cues, or the two groups which read pairs might have been helped by the opportunity to generate mediators (in the Control condition) or to process the mediators (in the Pairs condition). Similarly, the two groups which read only pairs would not have been interfered with in their learning by oral input at a slower speed than the visual input.

The case for the Low Achievers is less clear because of the equal performance of the Emphasis and Pairs groups. The reading speed hypotheses might predict that the three experimental groups would not differ if the visual input for the poorer readers was slow enough to match the auditory input. However, none of the groups provided with sentence mediation performed significantly better than the Controls, suggesting that the need for structure discussed previously was the major factor for determining differences among the Low Achievers, rather than visual distraction or opportunity to process mediators.

In line with the participation hypothesis, the Low Achievers may have been unable to generate mediators on their own, or even process provided mediators as required by the Pairs condition. Evidence for this suggestion lies in the larger differences between achievement levels for the Pairs and Control conditions than for the Paragraph and Emphasis conditions. The poorer readers thus might start out at about the same level as better readers in text learning tasks, but fall behind

when the opportunity is given to enter actively into the learning process. Essentially, this hypothesis re-states Levin's (1971) thoughts about the poor learner's tendency not to generate imagery while reading, suggesting a real qualitative difference in learning skills. This difference will be discussed further regarding the concept learning task.

If the poor readers were affected by instructions as previously suggested, when they were instructed to attend to the underlined words in the Emphasis condition and knew that they would be tested on the pairs, they might have found it simpler to attend to only the underlined words rather than reading the whole sentence. By eliminating visual distraction, this would have made the Emphasis task similar to the Pairs condition, where no printed elaboration was used.

To compare the present results in a rough way to those of Davidson, Schwenn, and Adams (1970) as they apply to visual inhibition, the types of overt errors made by each group were analyzed. The various types of errors were converted to proportions of the opportunities, i.e. overt errors, and are listed in Table 10. Types of errors were categorized as (1) test list errors, using a stimulus as a response or misplacing a response; (2) intrusions--extralist consisting mainly of associations, intralist including words from the text not appearing in the test list; and (3) description or synonyms including responses conceptually correct but specifically wrong (for example, a response of "He sailed around looking for places," instead of "explorer").

In support of the Davidson et al. (1970) findings, both groups which read the sentences showed a larger proportion of intralist errors

Table 10

Types of Overt Errors on PA Task

Experimental Condition	Opportunities for Overt Errors *		Test List Errors				Intrusions				Associations (Description)	
			Stimulus		Response		List		Non-List			
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Paragraph												
High	15	100%	0	0%	4	26.7%	4	26.7%	4	26.7%	3	20.0%
Low	17	100%	1	5.8%	3	17.6%	8	47.0%	4	23.5%	1	5.8%
Total	32	100%	1	3.1%	7	21.9%	12	37.5%	8	25.0%	4	12.5%
Emphasis												
High	18	100%	2	11.1%	7	38.9%	8	44.4%	1	5.6%	0	0%
Low	11	100%	0	0%	2	18.1%	3	27.3%	6	54.5%	0	0%
Total	29	100%	2	6.9%	9	31.0%	11	37.9%	7	24.1%	0	0%
Pairs												
High	6	100%	0	0%	3	50.0%	1	16.7%	2	33.3%	0	0%
Low	8	100%	2	25.0%	6	75.0%	0	0%	0	0%	0	0%
Total	14	100%	2	14.3%	9	64.3%	1	7.1%	2	14.3%	0	0%
Control												
High	4	100%	1	25.0%	3	75.0%	0	0%	0	0%	0	0%
Low	12	100%	2	16.7%	6	50.0%	0	0%	4	33.3%	0	0%
Total	16	100%	3	18.8%	9	56.3%	0	0%	4	25.0%	0	0%

*Overt Responses-Correct Responses

than the Pairs group which only heard the sentences but did not read them. Moreover, only the Paragraph group, instructed to learn about the story, made errors of the synonym-description type. Most of the errors made by the Pairs group were misplaced responses, which would be consistent with their freedom from visual distraction since it suggests that these Ss were more aware of what the correct response possibilities were and hence made errors almost exclusively within the pool of correct responses.

Concept Learning. The failure of the concept task to differentiate between groups was disappointing. The predicted superiority of the High Achievers, although significant, reflected very small differences between achievement levels within groups except for the Pairs group.

The mean four-item difference between achievement levels for the Pairs group equals their difference for the PA task. This is interesting because it reflects a trend (although non-significant) for the Low Achievers in the Pairs group to perform poorer than the other groups, while the High Pairs group showed the opposite trend (also non-significant). Again, it appears that the poorer readers may learn similarly to the better readers in a situation where the mediation is provided, but are unable to compete when called on to process the mediation for themselves, a situation which conversely enhances learning for the better readers.

Recent studies suggest that some inability to synthesize separate words of a sentence into a meaningful whole may be at least part of the problem for poor readers. Levin (1971), for example, in discussing the importance of meaning in learning suggested that good learners

organize their reading with imagery, presumably storing the image evoked from the words as a comprehensive whole.

Denner (1970) taught Head Start children, good and poor first grade readers, and third to fifth grade problem readers a logograph language where eight symbols each represented a word. All children were brought to a criterion of perfect recognition of the symbols. The children were then told to perform actions suggested by logograph sentences such as "Walk around teacher." Only the good first grade readers could synthesize nearly perfectly, exceeding even the third to fifth grade problem readers. Behavior of the non-synthesizing children was described as performing the actions separately, e.g. walking a few steps, then asking how to go around.

Apparently, inability to synthesize may not change with age and may be somewhat independent of intelligence and eventual success since Cromer (1970) found college students who were poor readers because they read word by word. When text material was synthesized for these readers by presentation in preorganized phrases, they comprehended at the same level as good readers.

Implications. Although this study added further evidence that reading and hearing the sentences is not facilitative for learning paired associates in contrast to hearing the sentences and reading the pairs, it suggested that this may be true only for good readers. The relationship of ability to synthesize with ability to learn and to use elaboration and possibly with social class may be an important one to consider not only in designing future research but also in the class-

room. In disregarding reading ability, and possibly other factors as well, researchers may be overlooking the individual "trees" for the group "forest".

Theoretical questions which have more commonly been considered as interesting areas for laboratory investig[illegible]on might have answers which, if they can be found, would be of real help to poor learners and their teachers. Could children be helped by reducing visual cues? Can children be taught to synthesize or organize material, or should special materials be devised for poor learners?

A useful implication of this study is that despite its departure from the more rigorous traditional laboratory methods, results similar to previous studies were found. This might encourage the application of elaboration in situations even closer to the school, perhaps to the actual textbooks and teaching methods used. There can certainly be no more relevant and important proving ground.

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APPENDIX A. TEXT

One of the many island countries in the South Pacific Ocean is Malahiki.

On a map of this area, Malahiki would appear as a small dot about three hundred miles southwest of Hawaii.

If we were approaching the island by airplane, we would see that it is roughly in the shape of a heart with the point of the heart on the east.

Malahiki was discovered in 1802 by Francis Farleigh, an Irish explorer, when he was blown off course during a storm.

Farleigh was forced to land on Malahiki and remained there with his crew, whose surnames of pure Irish, such as Reilly and O'Hara, are still given to native children.

Malahiki's tropical climate encourages the growth of many plants, especially the breadfruit, which supplied part of the food for the early natives.

The most important part of the Malahikan diet was seafood, which was caught with large nets or, in the case of larger fish or whales, with sharp spears called harpoons.

The oil from the whale blubber was used to light torches for the religious ceremonies.

Because the Malahikan religion was based on the worship of the moon, the islanders believed that on the nights when there was no moon that their gods were angry with them.

Huddling inside a magic circle formed by glowing torches, the entire community prayed for safety from terrible spirits called demons.

Today, the Malahikans have been able to fit new ideas into their old customs by a method called blending which has led to some changes in the religious life.

For example, flashlights have replaced the torches in the magic ring, and airplanes are the modern demons feared by the Malahikans.

APPENDIX B. PILOT DATA

Eleven fifth graders in a middle class suburban school were asked to read and comment on a passage similar to the final form form found in Appendix A. They were also asked to circle any of a list of 34 vocabulary words included in the passage which they did not understand both before and after reading the passage. Results of the questionnaire are tabulated below.

Question	Mean	Scale
Pre-Vocabulary (unknown words)	4.45	34 possible words
Post-Vocabulary (unknown words)	1.27	34 possible words
Easier or harder than textbooks	2.09	1 = much easier, 5 = much harder
More or less interesting	3.36	1 = much less, 5 = much more
Learn more about topic	3.00	2 = No, 3 = Maybe, 4 = Yes
Feeling about a test on topic	3.20	1 = terrible, 5 = great

Responses to an additional question, to draw or write anything about the story, were generally favorable and indicated that the children had learned some of the facts and ideas in the passage. For example, one of the drawings showed a ring of torches and some huts, another showed a heart-shaped island. Comments ranged from, "I liked the way the natives kept their religion and just changed a little," to "I liked it because it was different and better than baseball stories."

APPENDIX C. PA TASK

For elaboration conditions:

1. In what body of water was the island located?	(Pacific)
2. Malahiki was southwest of what place?	(Hawaii)
3. What was the shape of the island?	(heart)
4. What did Farleigh do for a living?	(explorer)
5. Of what nationality were the surnames of the crew?	(Irish)
6. Which of the plants was used for food?	(breadfruit)
7. What was the most important part of the Malahikan diet?	(seafood)
8. Where did the oil come from?	(whale)
9. What did the natives worship in their old religion?	(moon)
10. What did the islanders pray for safety from?	(demons)
11. What was the method used to keep the old way of life?	(blending)
12. What have flashlights replaced in the ceremonies?	(torches)

For the control condition:

1. With what did the word island go?	(Pacific)
2. The word southwest went with what word?	(Hawaii)
3. What word went with shape?	(heart)
4. What did Farleigh go with?	(explorer)
5. With what word did surnames go?	(Irish)
6. Which word did plants go with?	(breadfruit)
7. What was the word that went with diet?	(seafood)
8. What did the word oil go with?	(whale)
9. What was the word that went with religion?	(moon)
10. With what word did safety go?	(demons)
11. Which word did method go with?	(blending)
12. What word went with flashlights?	(torches)

APPENDIX D. CONCEPT TASK

How would life be different for a boy or girl your age living on Malahiki from your own life here in Wisconsin? Give me an example for each way I read to you:

1. The weather
2. Clothes
3. Food
4. How people make their living
5. Transportation
6. Religion
7. The kinds of things you might do in the water
8. Where you get the things you need, such as food or clothing
9. The type of buildings
10. What the children do to have fun
11. Names people might have
12. Things that are important for children to learn

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